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| Applicants: | Sascha Kreiskott | Docket No.: | S-99,952 |
| Serial No.: | 10/624,350 | Examiner: | Nicholas Smith |
| Filed : | 7/21/2003 | Art Unit: | 1753 |

For : HIGH CURRENT DENSITY ELECTROPOLISHING IN THE PREPARATION OF HIGHLY SMOOTH SUBSTRATE TAPES FOR COATED CONDUCTORS

Customer No. 35068

Mail Stop Appeal Brief - Patents
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Alexandria, VA 22313-1450

## APPEAL BRIEF

This Brief is filed pursuant to the appeal from the decision communicated in the Office Action mailed on January 9, 2008.

A Notice of Appeal is being submitted together with this brief.

### CERTIFICATE OF MAILING/TRANSMISSION (37 CFR 1.8(a))

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Juliet A. Jones

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## REAL PARTY IN INTEREST

The real party in interest in the present Appeal is the assignee, Los Alamos National Security, LLC, at Los Alamos National Laboratory.

## RELATED APPEALS AND INTERFERENCES

There are no known related appeals, interferences, or judicial proceedings.

## STATUS OF CLAIMS

Claims 1, 4, 5, and 9-13 stand finally rejected by the Examiner as noted in the Office Action mailed January 9, 2008. Claims 2, 3, 6-8 are canceled. Claims 14-19 are withdrawn as directed toward a non-elected invention.

The rejection of claims 1, 4, 5, and 9-13 is appealed.

## STATUS OF AMENDMENTS

No amendment was filed.

## SUMMARY OF CLAIMED SUBJECT MATTER

Claim 1 is directed toward a continuous process of providing a highly smooth surface (specification, page 4, lines 19-21) to a metallic tape (specification, page 4, line 22-page 5, line 3), the process comprising: passing a metallic tape consisting essentially of an uncoated polycrystalline nickel alloy (specification, page 4, lines 22-24) having an initial roughness of more than about 10 nm as a RMS roughness (specification page 5, linees 4-6) through an acid bath (specification, p. 5, lines 9-10) contained within a polishing section of an electropolishing unit (Figure 1, and specification, page 5, lines 14-21) over a pre-selected period of time; and, passing a mean surface current density of at least 0.37 amperes per square centimeter (specification, page 6, lines 13-16) through the metallic tape during the period of time the metallic tape is in the acid bath whereby the roughness of the metallic tape is reduced to a RMS roughness of less than about 1 nm

(specification, page 4, lines 19-21); and depositing a layer of oriented cubic oxide material (specification, p. 9, lines 1-8) onto the metallic tape having a roughness of less than about 1 nm, wherein the in-plane alignment of the oriented cubic oxide material is less than about 7 degrees (specification p. 12, lines 7-10).

## GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Rejection of claim 1 under 35 USC § 103(a) over Arendt (U.S. Patent Application 2003/0036483) in view of Rosswag (U.S. Patent 4,372,831) in further view of Faust (U.S. Patent 2,366,713). Dependent claims 4, 5 and 9-13 stand or fall together with Claim 1.

2. Rejection of claim 1 under 35 USC § 103(a) over Glowacki (Texture development in long lengths of NiFe tapes for superconducting coated conductor) in view of Rosswag (U.S. Patent 4,372,831). Dependent claims 4, 5 and 9-13 stand or fall together with Claim 1.

## ARGUMENTS

1. Rejection of claim 1 under 35 USC § 103(a) over Arendt (U.S. Patent Application 2003/0036483) in view of Rosswag (U.S. Patent 4,372,831) in further view of Faust (U.S. Patent 2,366,713).

The invention relates to a continuous chemical process of producing a highly smooth surface on a metallic tape. Specifically, by applying a mean surface current density of at least 0.37 amperes per square centimeter through a specific type of metallic tape (uncoated, polycrystalline nickel alloy) while the metallic tape is in an acid bath, Applicants have found that the roughness of the metallic tape may be reduced to a RMS roughness of less than about 1 nm. The Examiner admits that neither Arendt or Rosswag specify that the current density would be at least 0.37 amperes per square centimer (Office Action of January 9, 2008, page 3, paragraph 8), but states that Faust discloses

electropolishing nickel using current densities ranging from 100 to 500 A/sq. ft. (i.e., from 0.11 – 0.54 Amperes per square centimeter). Applicants believe that the combination of references fails to render the present invention obvious for the following reasons.

None of the cited references, individually or in combination, teach all steps of the claimed process, nor how to achieve a smoothness of less than 1 nm by electrochemical means. The Examiner states, "Faust discloses that the desired results of smoothness can be achieve[d] by longer periods of electropolishing (p. 2, col. 2, lines 20-36), and thus the time of electropolishing is a result-effective variable to achieve smoothness. Since the time of exposure is a result-effective variable as taught by Faust, it would have been obvious to one of ordinary skill in the art at the time of the claimed invention to electropolish at the desired current density by a routine optimization in order to obtain the desired smoothness." However, Faust fails to teach a result-effective variable relationship between higher current density and smoothness, and Applicants believe that this reference has been mischaracterized. Faust, p. 2, col. 2, lines 20-36 states:

> In order to obtain the best results in a reasonable length of time, it is preferable to use relatively high current densities, such as those of the order of magnitude of from 100 to 500 amperes per sq. ft. It will be understood, however, that lower current densities, even as low as 50 amperes per sq. ft. may be employed with consequent prolongation of the time of treatment. Higher current densities, up to as high as 2000 amperes per sq. ft., may also be used, but such high current densities imply, in general, larger currents, which require more expensive equipment. The length of time to effect the desired results depends upon the magnitude of the current densities employed and to some extent upon the characteristics of the nickel, its grain size and the like.

Thus, rather than teaching a result-effective relationship between current density and smoothness, Faust suggests a correlation between time of treatment and amount of current density, i.e. that lower current densities may be employed with longer treatment times (presumably to attain the same result) and that higher current densities may be used. However, Faust gives no indication of what that result may be. There is no indication of what the resulting smoothness is, or that smoothness is related to the amount of current. In addition, Faust teaches only electropolishing of nickel, whereas Applicants have found

that to obtain the requisite smoothness, an uncoated polycrystalline nickel alloy is required.

This argument put forth by the Examiner in regard to Faust is similar to arguments previously set forth by the Examiner in view of Rosswag, namely, that current density is a result-effective variable, and it would have been obvious for one of skill in the art to simply increase the current density to achieve smoother films. Office Action of July 27, 2007, page 4, paragraph 10. Rosswag teaches the use of an electrolyte solution comprising polyphosphate, at a temperature of 45 - 55°C, with a current density of 8 – 20 $A/dm^2$, for a duration of 5 – 10 min. There is no data in Faust or in Rosswag to suggest a linear – or any other result-effective - relationship between current density and resulting smoothness. There is nothing in Rosswag to suggest that extrapolation to a current density outside the range of 8 – 20 $A/dm^2$ is a valid assumption. In fact, one of skill in the art might assume that a higher current density would have a detrimental effect on the quality of the metallic surface, for example, due to etching or breakdown thereof.

Applicants further disagree with the Examiner's assertion that the present invention requires only "routine optimization." Electropolishing is an unpredictable art, subject to a number of interrelated experimental variables. Faust and Rosswag teach one such limited set of variables. Faust admits that "the length of time to effect the desired results depends upon the magnitude of the current densities employed and to some extent upon the *characteristics of the nickel*, its grain size and the like." [Emphasis added]. Applicants found, to their surprise, that by applying a higher current density to an uncoated polycrystalline nickel alloy having an initial roughness of more than about 10 nm, an extremely smooth surface could be achieved. This smoothness allows a layer of oriented cubic oxide material to be deposited onto the alloy, wherein the in-plane alignment of the oriented cubic oxide material is less than about 7 degrees. See specification p. 12, lines 7-10 in Example 1. Given the unpredictability of the field of art, and the lack of establishment of a result-effective relationship between any of these variables, Applicants believe that the assertion that Applicants' invention results only from routine optimization lacks sufficient foundation.

Finally, in regard to Arendt '483, Applicants believe that one of skill in the art would not be motivated to look to Arendt '483 to arrive at the present invention. This

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issue was fully addressed in the Declaration under 37 C.F.R. 1.132 by Paul Arendt of May 2, 2007, in which it was stated "Arendt '483 paragraphs [0015] and [0016] teach that a metallic substrate can be mechanically polished, electrochemically polished or chemically polished to reduce the RMS roughness, but, even if polished, the inert oxide layer must be deposited to give the substrate a RMS roughness of less than about 2 nm." Arendt teaches that chemical-mechanical polishing is necessary to provide a smooth surface, where "smooth" is meant a surface having an RMS roughness of less than 2 nm. Arendt [0016]. Applicants additionally point out that Arendt states that to obtain the desired smoothness [of less than about 1 nm], it can be preferred to treat the deposited inert oxide layer by chemical mechanical polishing. Arendt [0016]. Arendt further states that if the metal alloy starts out with an RMS roughness of less than about 15 nm, the metal substrate can be chemically mechanically polished (CMP) to a RMS roughness of about 1.5 nm, and if the metal substrate is much rougher, then the metal substrate is generally mechanically polished. Arendt [0018]. Thus, Arendt '483 clearly did not contemplate that an RMS roughness of less than 1 nm could be obtained by electropolishing alone and without a metal oxide layer being present prior to polishing.

For these reasons, Applicants believe that this combination of references fails to render the present invention obvious under 35 U.S.C.103(a).

2. Rejection of claim 1 under 35 USC § 103(a) over Glowacki (Texture development in long lengths of NiFe tapes for superconducting coated conductor) in view of Rosswag (U.S. Patent 4,372,831).

The Examiner admits that Glowacki in view of Rosswag does not specify that the current density would be at least 0.37 Amperes per square centimeter. The Examiner relies on Faust as disclosing electropolishing nickel using current densities ranging from 100 to 500 Amperes per square foot, and states that it would have been obvious to one of ordinary skill in the art to modify the method of Glowacki in view of Rosswag with the current density of Faust because Faust teaches that such current densities are efficient to achieve electropolishing within a reasonable period of time.

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Applicants first note that the Examiner only refers to Glowacki and Rosswag as references for the basis of this rejection, but then proceeds to rely on Faust. Applicants therefore first address the combination of Glowacki and Rosswag.

Neither reference suggests the feasibility of obtaining a surface with the claimed smoothness of less than 1 nm by electrochemical polishing. One of skill in the art would not be motivated to look to Glowacki to arrive at the present invention, as Glowacki teaches mechanical polishing. See Glowacki, p. 163, second full paragraph and page 167, first full paragraph. Glowacki then proceeds to explain:

> An alternative option investigated was an electropolishing technique which has greater flexibility and can be used on cube textured tapes. An initial study on "statically" electropolishing was concluded with a set of parameters (electrolyte composition, temperature, time, current). Initial work in Ni and NiFe tapes brought the roughness down from 0.20 μm to ~0.1 μm...

This suggests that the state of the art in the field of electropolishing in 2002, when Glowacki was published, was a smoothness of about 0.20 μm, which Applicants note is equal to 20 nm, or 20 times Applicants' claimed RMS roughness of about 1 nm.

Rosswag, which issued in 1983, teaches that current density in the upper range of 8 – 20 A/dm$^2$ results in *smoother* films. Like Faust, Rosswag fails to provide any indication of what is meant by the term "smoother." As explained above, Rosswag teaches the use of an electrolyte solution comprising polyphosphate, at a temperature of 45 - 55°C, with a current density of 8 – 20 A/dm$^2$, for a duration of 5 – 10 min. There is no data in Rosswag to suggest a linear – or any other result-effective - relationship between current density and roughness. There is nothing in Rosswag to suggest the validity of the assumption that extrapolation to a current density outside the range of 8 – 20 A/dm$^2$ would result in a smoothness of 1 nm or less, and no teachings beyond this defined range and under the limited experimental conditions outlined. Thus, one of skill in the art would similarly not be motivated to look to Rosswag to result in the process of the present invention.

For the reasons set forth above with regard to the combination of Arendt, Rosswag and Faust, Applicants believe that one of skill in the art would not be motivated to combine Faust with Glowacki and Rosswag. Faust, which issued in 1945, suggests only a

relationship between time of treatment and amount of current density, rather than between current density and smoothness. As in all the cited references, Faust gives no indication of what the resulting smoothness may be, however, it may be assumed that given the state of the art of electropolishing in 2002 as described in Glowacki, the smoothness Faust referred to was likely not an RMS of about 1 nm or less.

For these reasons, Applicants believe that this combination of references fails to render the present invention obvious under 35 U.S.C.103(a).

## CONCLUSION

For the above reasons stated in regard to both rejections, Applicants believe that the Examiner has engaged in impermissible use of hindsight in combining the aforementioned references. Applicants understand that any judgment on obviousness is in a sense necessarily a reconstruction based on hindsight reasoning. However, according to *In re McLaughlin* 443 F.2d 1392, 1395, 170 USPQ 209, 212 (CCPA 1971):

> "[a]ny judgement on obviousness is in a sense necessarily a reconstruction based on hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill in the art at the time the claimed invention was made and does not include knowledge gleaned only from applicant's disclosure, such a reconstruction is proper."

Applicants believe that the above rejections fail to take into account only knowledge that was within the level of ordinary skill in the art at the time of the claimed invention. None of the references give any indication that a RMS roughness of less than about 1 nm may be obtained by applying a current of at least 0.37 Amperes per square centimeter in an electropolishing process. None of the references suggest depositing a layer of oriented cubic oxide material onto the metallic tape which has an in-plane alignment of less than about 7 degrees.

Applicants further understand that there is no requirement that an express, written motivation to combine must appear in prior art references before a finding of obviousness, as stated in *Ruiz v. A.B. Chance Co.*, 357 F.3d 1270, 1276, 69 USPQ2d 1686, 1690 (Fed. Cir. 2004). However, Applicants point to the relatively recent holding of *KSR v. Teleflex*, 127 S. Ct. 1727, 1742, that it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the

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elements in the way the claimed new invention does. None of the references supply a reason to combine; rather, they would have been disregarded as unhelpful to one of skill in the art at the time of the invention.

In view of the arguments presented herein, it is respectfully submitted that the rejections under 35 U.S.C. 103(a) are improper.

Respectfully submitted,

Date: April 4, 2008

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## CLAIMS APPENDIX

Claim 1. A continuous process of providing a highly smooth surface to a metallic tape, the process comprising:

passing a metallic tape consisting essentially of an uncoated polycrystalline nickel alloy having an initial roughness of more than about 10 nm as a RMS roughness through an acid bath contained within a polishing section of an electropolishing unit over a pre-selected period of time; and,

passing a mean surface current density of at least 0.37 amperes per square centimeter through the metallic tape during the period of time the metallic tape is in the acid bath whereby the roughness of the metallic tape is reduced to a RMS roughness of less than about 1 nm;

depositing a layer of oriented cubic oxide material onto the metallic tape having a roughness of less than about 1 nm, wherein the in-plane alignment of the oriented cubic oxide material is less than about 7 degrees.

Claim 4. The process of claim 1 wherein the RMS roughness of the metallic tape is reduced to less than 0.5 nm.

Claim 5. The process of claim 1 wherein the acid bath consists essentially of a mixture of sulphuric acid and phosphoric acid.

Claim 9. The process of claim 1 wherein the metallic tape is in direct electrical contact with an anode in said electropolishing unit while said metallic tape is within an electrically conductive liquid throughout said electropolishing unit and within said acid bath in said polishing section, said acid bath further in contact with a cathode in said electropolishing unit so as to complete an electrical circuit.

Claim 10. The process of claim 9 wherein the anode includes a metal selected from the group consisting of titanium, niobium, tantalum, platinum, rhenium, rhodium, nickel, chromium, gold and silver.

Claim 11. The process of claim 10 wherein the acid bath consists essentially of a mixture of sulphuric acid and phosphoric acid.

Claim 12. The process of claim 1 wherein the metallic tape is in direct electrical contact with an anode in said electropolishing unit while said metallic tape is in contact with mechanical contacts as the metallic tape is passed through the acid bath so as to complete an electrical circuit.

Claim 13. The process of claim 1 wherein the metallic tape is passed through the acid bath and the acid bath provides electrical contact with the metallic tape.

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EVIDENCE APPENDIX

NONE

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RELATED PROCEEDINGS APPENDIX

NONE

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## TRANSMITTAL OF APPEAL BRIEF

1. Transmitted herewith is the Appeal Brief in this application with respect to the Notice of Appeal filed on April 4, 2008.

2. Attached is a Fee Transmittal Form.

Respectfully submitted,

Date: April 4, 2008

Signature of Attorney

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